# Perspectives for $t\bar{t}$ cross section measurement at ATLAS

M. PINAMONTI $(^1)$ 

 Università degli Studi di Trieste and INFN Gruppo Collegato di Udine, Strada Costiera 11, 34151, Trieste

**Summary.** — The top-antitop pair production is one of the dominant processes in proton-proton collisions at multi-TeV energies. Here are presented the prospects for measuring the total top pair cross-section with the ATLAS detector using 200  $pb^{-1}$  of data taken at 10 TeV. The cross-section is determined in the single-lepton channel, and in the di-lepton channel. Data driven methods are studied to estimate the main background in both channels.

PACS 29.85.Fj – Data analysis.

### 1. – Introduction

Besides allowing a direct comparison with theoretical calculations, the measurement of the top-pair production cross section at the LHC will likely be the first one implying the reconstruction of final states including jets, electrons (e), muons ( $\mu$ ) and missing transverse energy ( $\not\!\!\!E_T$ ), and therefore it is an essential stepping stone toward the identification of new physics.

The analyses, in the single-lepton and di-lepton  $t\bar{t}$  decay channels, have been performed using Monte Carlo (MC) samples and full simulation of the ATLAS detector, assuming a center of mass energy of 10 TeV and considering an integrated luminosity of 200 pb<sup>-1</sup>. A more detailed description of the analyses can be found in [1].

## 2. – Event selection

For single-lepton events, the base selection consists in requiring: an e or  $\mu$  trigger fired, exactly one isolated lepton (e or  $\mu$ ) with  $p_T > 20$  GeV,  $\not{\!\!E}_T > 20$  GeV, at least four jets with  $p_T > 20$  GeV, of which at least three jets with  $p_T > 40$  GeV, at least one di-jet combination inside the hadronic top candidate with invariant mass within 10 GeV from W peak mass. The hadronic top candidate is defined as the three-jet combination of all jets with the highest transverse vector sum momentum. In the  $t\bar{t}$  hypothesis, two of these three jets come from the decay of a W boson.

ON BEHALF OF THE ATLAS COLLABORATION

<sup>©</sup> Società Italiana di Fisica

TABLE I. – Left: Expected number of signal (S) events, total background (B) events and S/B ratio, for the different channels. QCD background is not included. Right: Expected relative uncertainties (%) on the  $t\bar{t}$  cross section determination for different channels and methods. The errors coming from the statistics, from the systematic uncertainties and luminosity uncertainty are shown separately.

							cut&count / fit		cut&count		
	$e_{+ { m jets}}$	$\mu_{+ m jets}$	ee	$\mu\mu$	$e\mu$		$e_{+ { m jets}}$	$\mu_{ ext{+jets}}$	ee	$\mu\mu$	$e\mu$
S	1286	1584	214	327	683	stat.	3.0 / 14	3.0 / 15	8.5	6.6	4.3
В	598	799	54	87	123	syst.	$14.5 \ / \ 10.5$	$13.5 \ / \ 10.5$	13.3	9.8	9.1
S/B	2.1	2.0	3.9	3.8	5.6	lumi.	22 / 20	22 / 20	22	22	22
						TOT	27 / 27	26 / 27	27	25	24

Table I (left) summarizes the expected number of signal and background events.

#### 3. – Cross section determination and systematic uncertainties

For both the single- and di-lepton channels, the  $t\bar{t}$  cross-section can be obtained by performing a counting experiment, *i.e.* by subtracting the estimated number of background events from the number of observed events passing the selection, and dividing by the integrated luminosity and the selection efficiency. A second method, called likelihood fit, has been studied for the single-lepton channel. It consists in extracting both signal and background simultaneously by fitting the hadronic top candidate mass distribution.

Table I (right) shows the expected uncertainties for different channels and methods.

#### 4. – Data-driven background evaluation

For the counting method in particular, it is essential to rely on data-driven methods to estimate the major backgrounds, while for the smaller ones, MC simulation is used.

The W+jets background, the main expected background for the single-lepton channel, can be extracted from data by assuming the ratio between Z+jets and W+jets cross sections constant as a function of the number of jets. Counting the number of Z+4jets allows to predict the number of W+4jets.

The Z+jets residual background in the di-lepton channel, after the  $m_Z$  veto (for the ee and  $\mu\mu$  channels), can be extracted from data assuming that the  $\not\!\!E_T$  and the  $m_{\ell\ell}$  are uncorrelated, and counting the events in different regions of the  $\not\!\!E_T v.s. m_{\ell\ell}$  plane.

To estimate the fake lepton background in both the single- and di-lepton channels, a method called "matrix method" can be used. The method consists in defining a *loose* and a *tight* isolation selections for leptons, counting the number of events passing each selection, and solving a system of equations by giving as input the probabilities of a *loose* lepton to pass the *tight* selection for *real* and *fake* leptons.

# REFERENCES

[1] ATLAS COLL., ATL-PHYS-PUB-2009-086, ATL-PHYS-PUB-2009-087, (2009).